Comparative Study of Emission Factors and Mutagenicity of Red Oak and Peat Smoke from Smoldering and Flaming Combustion

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Wildfire events produce massive amounts of smoke and thus play an important role in local and regional air quality as well as public health. It is not well understood however if the impacts of wildfire smoke are influenced by fuel types or combustion conditions. Here we developed a novel combustion and sample-collection system that features an automated tube furnace to control combustion conditions and a multi-stage cryo-trap system to efficiently collection particulate and semi-volatile phases of smoke emissions. The furnace sustained stable flaming and smoldering biomass (red oak and peat) burning conditions consistently for ~60 min. The multi-stage cryo-trap system (-10°C followed by -47°C, and ending in -70°C sequential impingers) collected up to 90% (by mass) of the smoke. Condensates were extracted and assessed for mutagenicity (polycyclic aromatic hydrocarbons (PAHs)- and nitroarene-type activity) in *Salmonella* strains TA100 and TA98+/-S9. Carbon dioxide, carbon monoxide (CO), and particulate matter (PM) concentrations monitored continuously during the combustion process were used to calculate modified combustion efficiency (MCE) and emission factors (EFs). We found that the MCE during smoldering conditions was 74% and 71% and during flaming conditions was 99% and 96% for red oak and peat, respectively. Red oak smoldering EFs for CO and PM were 209 g/kg and 147 g/kg, whereas flaming EFs were 16 g/kg and 0.6 g/kg, respectively. Peat smoldering EFs for CO and PM were 301 g/kg and 59 g/kg, respectively, whereas peat flaming EFs were 47 g/kg and 3 g/kg, respectively. The ranking of the mutagenicity-emission factors (revertants x $10^5/MJ_{th}$ in TA100 and TA98+S9, respectively) was red oak smoldering (14.1 and 6.3) > peat smoldering (13.7 and 4.1) > peat flaming (2.5 and 0.8) > red oak flaming (0.3 and 0.1). The greater mutagenicity in TA100+S9 than TA98+S9 indicates that the mutagenicity was associated with PAHs. The results demonstrate that 1) type of fuel and combustion conditions have dramatic differences in emission characteristics and mutagenicity, and 2) the presented system can be useful for the health risk assessment from inhalation exposure to wildfire smoke. [This abstract does not represent official USEPA policy.]